COMPLEMENTING THE TRADITIONAL HIERARCHY OF AVIATION SAFETY CONTROLS WITH A BEHAVIOR-BASED SAFETY SYSTEM: PRELIMINARY FINDINGS FROM THE COLLEGE OF AVIATION AT WESTERN MICHIGAN UNIVERSITY

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ABSTRACT

General approaches to minimizing risk in aviation typically involve engineering controls, procedural controls, and training controls. To make further strides in reducing the risk of accidents and incidents in aviation, we may need to compliment the traditional hierarchy of safety controls with aspects of a proactive approach utilized successfully over the past twenty years in manufacturing and business settings called Behavior-Based Safety (BBS). The College of Aviation at Western Michigan University is in the process of incorporating aspects of BBS principles into the daily activities of flight training. The assessment phase of our project profiled the most frequent occurrences in our organization and the characteristics of the population at-risk. Other findings of the assessment are discussed as well as current research and strategic planning activities related to implementing BBS principles in flight school operations.

INTRODUCTION

Traditional aviation safety controls can be found in superior engineering solutions, policies and procedures, and preliminary and remedial training. These traditional controls protect the safety of flight operations either through better human-machine interfaces or by illustrations of procedures for common at-risk operations outlined in a dynamic standard operating procedures manual. Training is used to teach the knowledge and practices of safe operations and to provide a protected environment in which a student's learning boundaries can be widened. These traditional safety controls have developed in response to past operational errors, which would lead us to believe that improved engineered solutions or training solutions should prevent the recurrence of those past errors. However, even when superior engineering, procedural, and training systems exist, what aviators *do* on a daily basis is not always attended to in a systematic and data-oriented fashion. In other words, there is often a data and/or problem solving gap in the typical safety management system. If we know what people should do to minimize risk, how can we facilitate that doing? Some would argue that we should focus on improving safety attitudes to encourage compliant and diligent safety related behavior.

With the vast amount of technical tasks to learn and flight maneuver standards to master, the world of flight students is complex. This is why one of the most important safety controls for flight schools is ensuring that training systems are standardized, thorough, and teaching the right types of skills. However, when accidents and incidents occur, in spite of rigorous standards and safety precautions, attempts to improve and remediate student safety are often limited to accident analyses and lectures about following procedures. The violation of safety procedures is sometimes blamed on a person's attitude or apathy regarding the importance of relevant issues. The problem with implicating safety attitudes is the difficulty of teaching them to flight students. Attitudes are inferred, complex psychological constructs, which involve at least three components. In theory, to change a safety attitude you must describe and change a set of actions, feelings, and thoughts (Brethower, 2000). Being multifarious, attitudes can become quite complicated and convoluted. Moreover, they are difficult to assess because of their privacy. That is, only the students can know their true thoughts and feelings. When asked about safety attitudes, students are likely to respond positively, reflecting the prevailing importance of safety in aviation. Even more problematic is the fact that attitudes and actions are not always consistent (Guerin, 1994). One can express an attitude but not act in a manner consistent with it.

The good news is that psychologists working in business and industry have pioneered an approach to improving safety attitudes that focuses on manageable behavioral performance targets (Krause, 1997). When behavior changes, attitudes are likely to shift as well, with individuals

maintaining consistency between attitudes and behaviors (Guerin, 1994). This approach, usually labeled Behavioral Safety or Behavior-Based Safety (BBS) represents a proven set of methods for increasing and facilitating safe behavior, positively impacting safety attitudes, and reducing accidents and injuries (for recent literature reviews see Grindle, Dickinson, & Boettcher, 2000; Sulzer-Azaroff & Austin, 2000).

BEHAVIOR-BASED SAFETY

BBS processes developed from the traditions of Total Quality Management, Applied Behavior Analysis, and Human Performance Technology. As the label for this approach to safety management suggests (*behavior*-based safety), the guiding logic of BBS processes is that exemplary reductions in accidents and injuries are possible when organizations complement the traditional hierarchy of safety controls by focusing upstream on behavior.

In the late 1970's, pioneering psychologists in the area of occupational health and safety recognized the fact that property damage, injuries, and fatalities are relatively infrequent and highly variable in their characteristics. The traditional practice of investigating, measuring, and tracking only untoward safety outcomes had left safety management personnel and employees with little to no feedback and reinforcement for their daily safety related performance. This state of affairs can result in at-risk behavior motivated by chance factors occurring in each person's daily interactions and operations. Performing safely is often effortful, time consuming, or difficult. Taking risks, however, can often save time, require less effort, or pay off in some other way in the short term. In other words, without a proactive management system focused upon the behavioral level of safety, natural consequences for behavior can encourage taking risks, in spite of the best engineering and procedural safety controls. In the 21st century innovative organizations in manufacturing and industry have adopted such behavioral systems. Theses systems generate frequent proactive measures of critical safe behaviors and conditions and provide frequent feedback and reinforcement for performers. By focusing on active performances, BBS enables goal setting and achievement in safety that is not possible with accident and incident data alone. Such systems also present opportunities to identify engineering, procedural, and training problems before they develop into serious occurrences.

While the logic of BBS is straightforward, implementing such systems is easier said than done. BBS requires reviewing historical accident/incident data for patterns and "hot spots," reviewing data related to "close calls" and sampling perceptions of the most important and/or frequent safety concerns, frequent measurement of behaviors and conditions related to preventing the most relevant accidents/incidents, analysis of the root causes of behavioral deficits, frequent feedback for performers and celebrations for effort and performance improvement, responsive problem solving when the data reveal concerns, and finally, a long-term commitment to continuous improvement. Implementing a BBS process involves four main phases: 1) assessment, 2) process design and development, 3) implementation, and 4) evaluation and continuous improvement.

The assessment phase usually consists of historical accident/incident data analysis, a review of any other available data related to "close calls" or the costs incurred from property damage or injury, interviews with a representative sample of the organization, and baseline data collection. A good analysis can identify high-risk areas and activities (McSween, 1995). Following the assessment, a small group of empowered individuals, sometimes called a steering team, should design and plan for the implementation of measurement and feedback systems for critical performances identified in the assessment. One result of daily attention to safe and at-risk behavior is that immediate, specific, and positive reinforcement in the form of feedback can be delivered to the participant. Providing positive, immediate, and certain consequences for performing safely can increase or maintain the future frequency of that behavior (Komaki, Barwick, & Scott, 1978). And, as mentioned previously, daily measurement of important safe and at-risk behavior can present opportunities for performers to communicate systems problems or other issues that prevent safe performance. Once the process has been designed to fit into an organization's existing practices it is time to communicate the expected changes to daily activities to all those who will be involved and implement the process. Implementation can be viewed as the beginning of a long-term commitment to continuous improvement. In order to truly accomplish and exist in the fourth phase of a BBS implementation, leadership must respond to concerns raised by behavioral data and adjust the process to meet the dynamic and changing needs of the organization.

Assessment

Our BBS assessment consisted of (a) analyzing all historical accident and incident reports available across 28 potentially important dimensions, (b) analyzing over 100 safety reporting forms filed with the safety committee that described at-risk events or near incidents observed by students and instructors; and (c) interviewing approximately 30% of current flight students and instructors.

This phase of the project revealed that the most frequent type of accident/incident at the College was an excursion from the runway. The population at-risk for this type of occurrence was students with 0 to 30 total flight hours experience, especially students with 10 or fewer hours of solo flying experience. The analysis of safety reporting forms revealed that the most frequently reported safety concern was a traffic conflict in the pattern. In contrast to data describing accidents and incidents, these forms reported safety concerns happening, for the most part, on dual flights. [It should be noted that we present only a few essential details of our assessment here. As mentioned previously, accidents and incidents were analyzed across dimensions other than type of occurrence and pilot characteristics, as were safety-reporting forms. Readers interested in performing a similar assessment should feel free to contact any of the authors directly or to see McSween (1995) and/or Krause (1997) for guidance.] Interviews revealed general agreement that air traffic conflicts were a frequent safety concern. Students expressed a strong desire for access to more safety related information regarding accidents and incidents at the College and close calls described in safety reporting forms. Students tended to view instructors as excellent models of safety but viewed student peers in a less favorable light. It is important to note that engineering, procedural, and training safety controls utilized at the College were generally praised by those interviewed. With regard to implementing behavioral safety controls, instructors and students alike were generally supportive of the idea of frequent behavioral observation and feedback related to critical safety related performances. And finally, interviews also uncovered several other potential behavioral targets for the BBS initiative, including aspects of pre-flight activities and ground operations.

Current Activities

The assessment identified safety priorities for the College, suggesting specific behavioral performances that could become the original focus of a BBS initiative. Furthermore, a specific population was identified as being at-risk for our most common accidents and incidents. In response to these data, research was initiated by the second author aimed at tracking the acquisition of landing skills from 0 to 30 hours of total flight experience. It is hoped that this research will reveal the greatest learning challenges and the most frequent errors among new flight students as they learn complex landing skills, indicating areas of focus for training solutions. The two methods currently being used to collect these data are videotaping landings and administering and collecting student-landing diaries. Flight instructors are also likely to become involved in the data collection in near the future.

In keeping with the purposes of a BBS assessment, the College is also begun strategic planning for safety management, including the implementation of a BBS process for flight operations. In addition to the complex issues related to landing performance, likely initial targets for the BBS process include following procedures in the pattern, pre-flight activities, and other ground safety issues. It is hoped that implementing a BBS process will ultimately reduce accidents and incidents, but we also hope to increase student involvement in safety, improve safety related communication with students, and strengthen safety attitudes through a focus on observable behavior.

Future Activities

The challenges faced at our training facility are common to most flight schools. One important future activity will be using behavioral and performance measures from the BBS process to test and develop innovative training strategies related to the acquisition of critical landing skills. If any flight school is serious about reducing accidents and incidents, the most critical performances must be measured thoroughly and frequently. This can be accomplished in part through using a BBS process to complement traditional safety controls.

CONCLUSION

A safety assessment is the first component in a BBS initiative and key to its ultimate success.

Behavioral safety controls must be directly related to the accidents, incidents, and at-risk events common to the organization in order to ultimately impact occurrence rates. However, before an organization rushes forward with a behavioral initiative, it is important to diligently work on a strategic plan for the rollout of such a major change to daily operations. Change initiatives in organizations are complex and should be carefully planned and customized to the relevant organization. It is hoped that our current and future efforts in this area will create a more complete safety management philosophy and culture at the College, complementing traditional safety controls with much needed BBS processes.

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